

# First Record of a Sacoglossan (= Ascoglossan, Opisthobranchia) from Patagonia (Argentina): Description of a New Species of Genus *Elysia* Risso, 1818

by

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**Abstract.** A new species of the genus *Elysia* Risso, 1818, is described: *Elysia patagonica* sp. nov. The material examined represents the first sacoglossan species recorded from the Argentinean coast (San Jorge Gulf, 45°58'S, 67°34'W, Patagonia). The study is based on systematic descriptions and biological information recorded during the austral summer, from 40 living specimens collected from the same locality. *Elysia patagonica* is distinguished from Atlantic *Elysia* species. The presence of *Elysia patagonica* at this latitude greatly extends the known range of the order Sacoglossa (= Ascoglossa) in South America.

## INTRODUCTION

The order Sacoglossa Ihering, 1876, has never been reported among studies of the opisthobranch mollusks from Argentina. The most comprehensive studies of the Magellanic Province mollusks have been: Carcelles, 1950; Carcelles & Williamson, 1951; Scarabino, 1977; and Castellanos et al., 1987, 1993.

Marcus (1980) carried out the most recent revision for the genus *Elysia* Risso, 1818, from the western Atlantic, in which the distribution of species extended from Nova Scotia (45°N, 65°W) to Brazil (24°S, 45°W), with no existing records of its presence at any more southerly points.

The first record of a sacoglossan for the Argentinean coasts is reported in this paper, with descriptions of the

external morphology and anatomy, and comments on the ecology and biology of this new species. The species is compared with other *Elysia* species, principally those present in the Atlantic Ocean.

## MATERIALS AND METHODS

Forty specimens of *Elysia* were collected at Punta Marqués (45°58'S, 67°34'W), San Jorge Gulf, in the Magellanic Province, according to Balech's (1954) biogeographic division (Figure 1). Specimens were collected by the former author on intertidal rocks, in tide pools during low tide, in the austral spring and summer (Table 1). A mean surface temperature of 16°C was measured in tide pools ( $n = 30$ ; between 12/26/94 and 01/05/95). Total live length was measured. The animals were maintained in aquaria for several days to obtain information about their feeding and reproductive behavior. After live study, they were frozen in seawater for 3 to 5 hours to obtain totally

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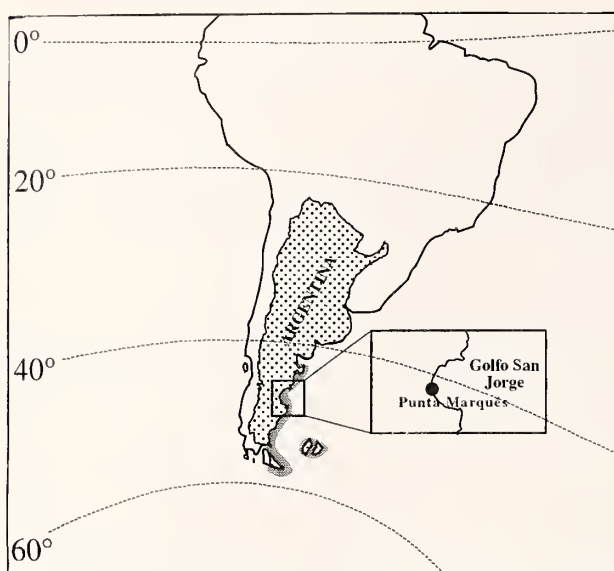


Figure 1

Map of South America, showing the Atlantic Magellanic Province (dark shadow) and the type locality of *Elysia patagonica* Muniain & Ortea, sp. nov.

opened parapodia; later they were fixed in formaldehyde seawater 4%. This technique makes it easier to obtain a detailed description of the pericardial region and to assess the dorsal vessel distribution. Several specimens were dissected and their internal organs described. The radula and penis (critical point dried) were examined by scanning electron microscope (SEM).

The material examined is deposited in the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (Buenos Aires).

## SYSTEMATICS

*Elysia patagonica* Muniain & Ortea, sp. nov.

(Figures 2–8)

**Type material:** The holotype (MACN 33780, 01/09/95, 51 mm) and four paratypes (MACN 33880, 01/09/95, 36 mm (dissected), 33 mm, 49 mm, and 38 mm).

**Diagnosis:** Large species. Intense dark green coloration speckled densely by silvery and bluish spots throughout the body surface. Patch of white iridescent spots over the medial dorsal region of the head. Ample parapodia with extensive folds and dorsal vessels well developed. Globular renopericardial prominence, two principal dorsal vessels and many branching lateral. Blade-shaped teeth with blunt tips and finely denticulate cutting edges.

**External morphology:** The specimens collected are between 9 and 70 mm (total length alive). Intense dark green

Table 1

Examined material of *Elysia patagonica* from Punta Marqués (Patagonia). Date: collection date, *n*: sample size, Size: length range (mm), Alga: seaweed where the animals were collected.

Date	<i>n</i>	Size	Alga
11 Jan. 92	9	28–50	<i>Bryopsis plumosa</i>
26 Oct. 92	3	18–26	<i>Bryopsis plumosa</i>
20 Dec. 93	1	36	<i>Bryopsis plumosa</i>
31 Dec. 94	12	17–43	<i>Bryopsis plumosa</i>
4 Jan. 95	1	9	<i>Codium</i> sp.
9 Jan. 95	14	32–70	<i>Bryopsis plumosa</i>

coloration like the host algae, speckled with silvery and bluish spots densely distributed throughout the parapodial surface. The size of spots varies, appearing as white iridescent blotches on the parapodial edges (Figure 2A). A conspicuous aggregation of white spots is present over the medial dorsal region of the head, constituting a patch (Figure 2B). This patch varies among animals, but it is always conspicuous (Figure 3). The expanded parapodia and edges exhibit extensive folds, giving them a leaflike appearance. The maximum parapodial width is between 20 and 38 mm. The renopericardial prominence is situated behind the head, and it has a marked globular aspect with small branching veins on the anterior portion. Over the rest of it, cream coloration can be observed through the "translucent" mantle. Around the heart region, there is a smooth ring, with spots as noted over the rest of the body. The dorsal vessels are well developed. The branching of the lateral dorsal vessels begins from two parallel trunks that start in the pericardial area and end at the posterior parapodial region. In some large animals, this vessel distribution forms a dark smooth band around the parapodia. The dark appearance of this band is due to the fact that the vessel distribution does not reach the parapodial edge (Figure 4).

Ventrally, the parapodia are completely smooth, without vessels, but with identical coloration to the dorsal surface. The foot is light yellow in color, dorsally visible only in the anterior portion, projecting beyond the sides of the head (propodium) (Figure 2D). The sole foot has an anterior transverse groove, situated below the neck end. The size of the metapodium coincides with the head and neck length. The head and rhinophores are the same color as the rest of the body, but the end of the rhinophores is lighter. In the largest specimens, the head is often covered by folds of the large parapodia. The eyes are located laterally, behind the rhinophores. The rhinophores are long and rolled, with a wide groove. The anal papilla is prominent on the right side, just anterior to the renopericardial prominence.

**Anatomy:** Internal organs are situated between the head and pericardial region, occupying one-third of the body



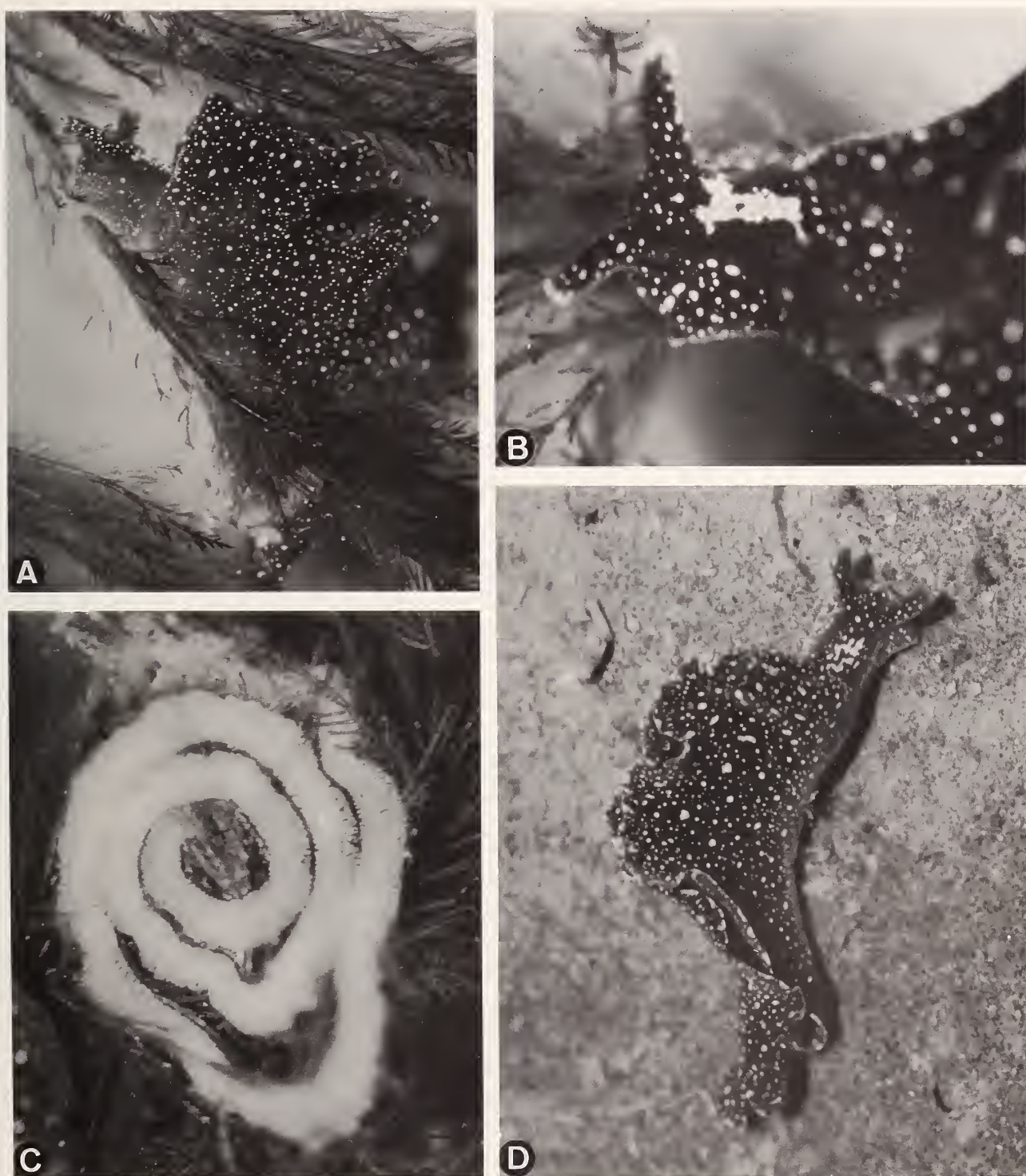


Figure 2 (A-D)

Living animals of *Elysia patagonica* Muniain & Ortea, sp. nov. A. Animal feeding on *Bryopsis plumosa*. B. Dorsolateral view of the head showing the patch of white spots. C. Spawn eggs on the host algae. D. Specimen (35 mm) with closed parapodia, projecting the foot beyond the sides of the head.





Figure 3

Dorsal view of three different heads showing variations in the patch of white spots.

length. The rest of the body is represented by parapodial extension, where the digestive vessels and some reproductive follicles are situated throughout the surface.

*Digestive tract.* The pharynx is 1.2 mm (length) with a well-developed dorsal septate muscle and a short ascus muscle. At the beginning of the esophagus, there is a nerve ring with the main ganglia (two pedal, two cerebral). At both sides of the esophagus, there are two long and narrow salivary glands. At the end of the esophagus, a muscular esophageal pouch opens. The stomach is ample in its first section (ventral); from it, a long main duct of the digestive gland extends in the parapodial caudal direction. The second section (dorsal) is elongated, muscular, and thinwalled.

The intestine is expanded; the epithelium is strongly muscular (Figure 5A).

*Radula.* The ascending limb of the radula in the 40 mm individual (length alive) contains seven fully formed teeth, one partially formed tooth at the beginning, nine in the descending limb, and many discarded teeth in the ascus (Figure 6A). The teeth are blade-shaped and finely denticulate in the cutting edges. The longest tooth is the first in the descending limb (approx. 230  $\mu$ m). Each tooth shows a developed "hooked-base" (Figure 6B-F).

*Reproductive system.* The reproductive system is complex, as in the rest of the family Elysiidae. The penial opening is situated at the base of the right rhinophore.

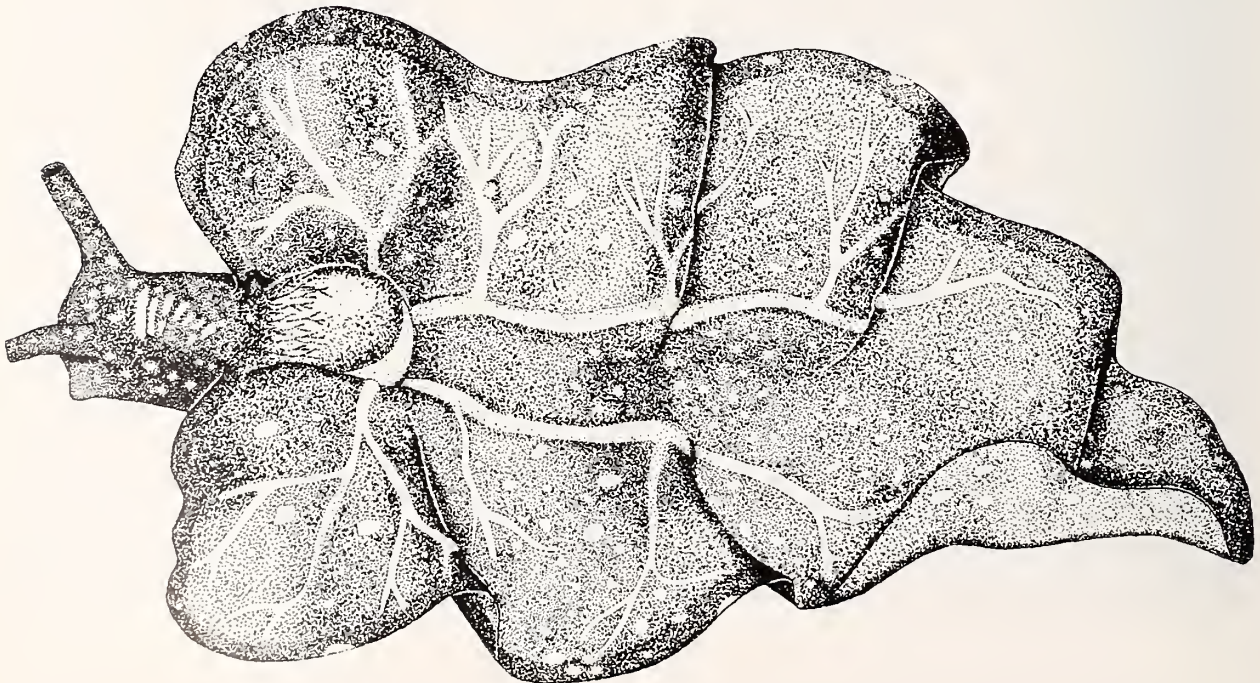


Figure 4

Dorsal view of live animal (40 mm) showing the expanded parapodia with the renopericardial prominence, anal papilla, and dorsal vessel distribution.

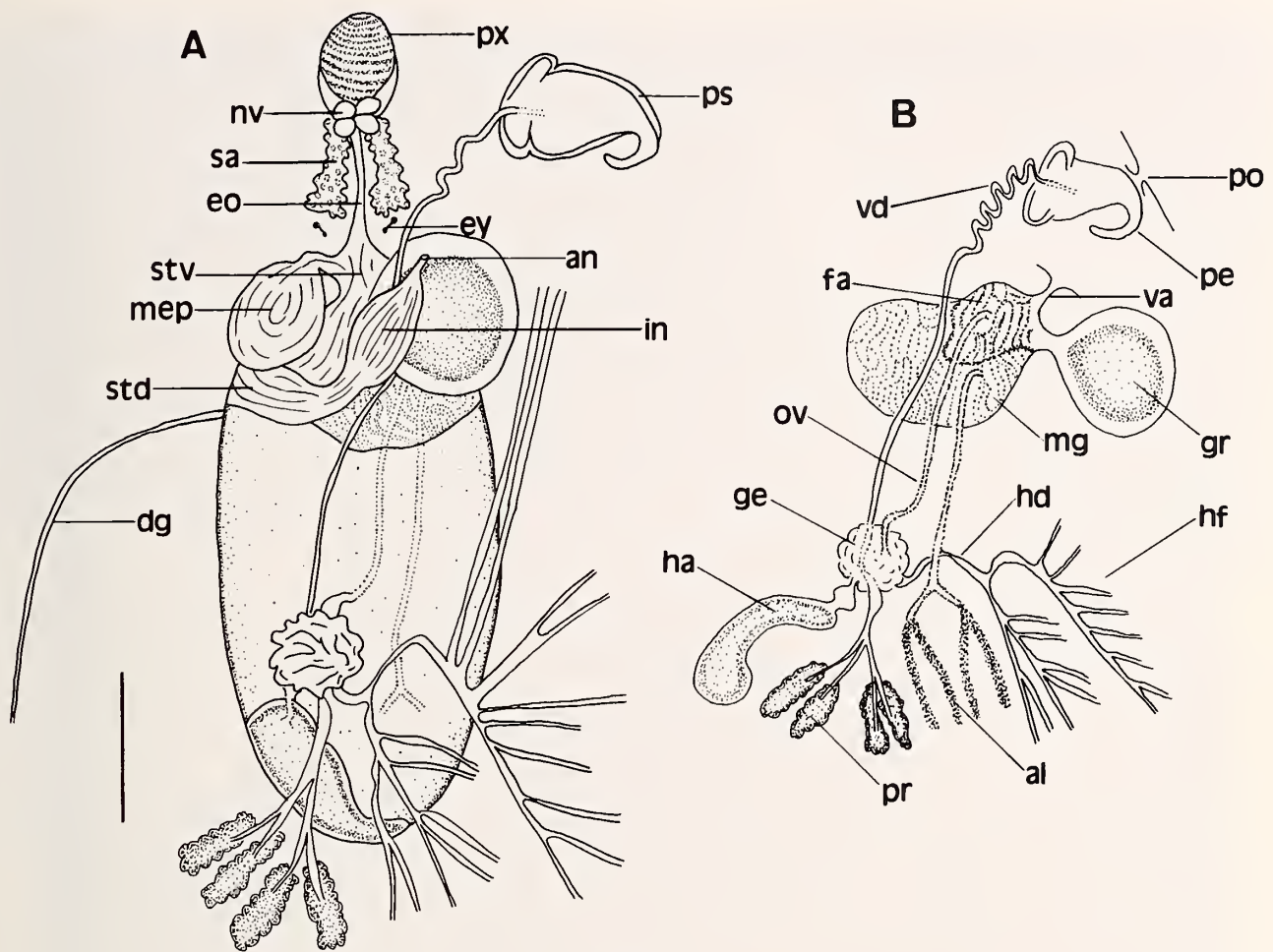


Figure 5

Anatomy of *Elysia patagonica* Muniain & Ortea, sp. nov. (paratype MNBR: 33880, 36 mm). A. Dorsal view of the internal organs, digestive tract, scale bar: 2 mm. Key: an, anus; dg, duct digestive; eo, esophagus; ey, eyes; in, intestine; mep, muscular esophageal pouch; nv, nerve ring; px, pharynx; sa, salivary glands; std, dorsal portion of stomach; stv, ventral portion of stomach. B. Reproductive system. Key: al, albumen glands; fa, fertilization area; ge, globular structure; gr, genital receptacle; ha, hermaphrodite ampulla; hd, hermaphrodite duct; hf, hermaphrodite follicles; mu, mucus gland; ov, oviduct; pe, penis; po, penial opening; pr, prostate; ps, penial sheath; va, vagina; vd, vas deferens.

The penis is large (approx. 500  $\mu$ m expanded), naked, and drawn into a penial sheath (in all dissected specimens). A wide and thick base is visible when the penis is expanded, although it terminates in an unarmed tip. The vas deferens at the beginning of the penial base is convoluted (Figure 7), and subsequently very long, running from the penis into a globular structure, which also receives separately the ducts from the hermaphrodite follicles and the large hermaphrodite ampulla. The hermaphrodite follicles are densely distributed throughout the parapodia, and cream ovate structures are seen in all the extension. The prostate gland is branched and separated to the hermaphrodite follicles. The vaginal opening cannot be observed exter-

nally, but the vagina lies at the lateral wall in the transverse groove. A large and spherical genital receptacle (bursa copulatrix) is connected by a wide duct to the female reproductive system. Two inner ducts connect with the fertilization area and the mucus gland apparently, one of them (oviduct) from the globular structure, and the second from the albumen glands (Figure 5B).

**Biology and ecology:** *Elysia patagonica* sp. nov. lives mainly on the green alga *Bryopsis plumosa*, where it feeds and spawns. Only one specimen occurred on *Codium* sp. The egg mass consists of a yellow jelly ribbon, with a spiral shape of concentric loops (Figure 2C). The largest





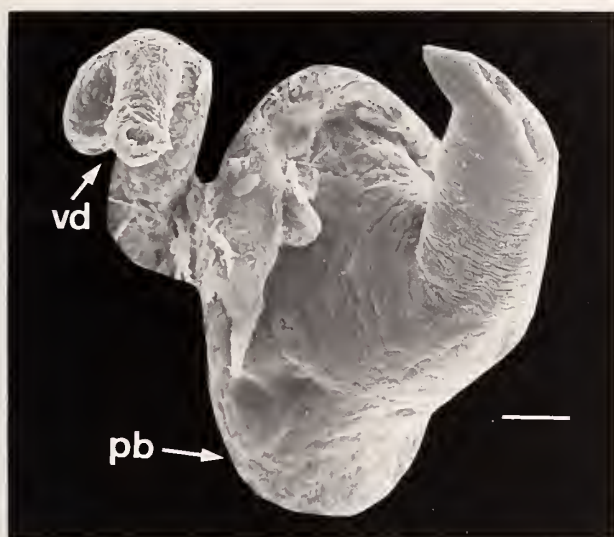


Figure 7

Scanning electron micrograph of the penis (paratype). Key: **pb**, penial base; **vd**, vas deferens. Scale bar: 100  $\mu$ m.

spawn can have up to seven loops. Inside every capsule there is normally more than one embryo (Figure 8). The capsules range from 250–300  $\mu$ m in diameter.

**Etymology:** The name describes the most austral zone of Argentina: Patagonia, where the species was collected.

### DISCUSSION

Marcus (1980) completed the last revision of *Elysia* from the western Atlantic Ocean and discussed the geographical distribution of species from Florida to Brazil. None of them approximate the characteristics of our specimens. To compare them, we have taken into account coloration (no preserved), size, vessel distribution, teeth and penial morphology, and the algae in their diet. Features of the reproductive system can often be important when comparing descriptions of some species; however, in many studies such descriptions are absent, owing to the complexity of the reproductive system. On other occasions, differences in terminology made comparisons difficult (Marcus, 1980; Jensen, 1992). *Elysia ornata* Swainson, 1840, lives on *Bryopsis plumosa* (Jensen, 1993a and our data) and reaches a maximum size of 50 mm. However, *E. ornata* has a conspicuous black and orange band that borders the parapodia, and the dorsal vessel distribution and radula differ

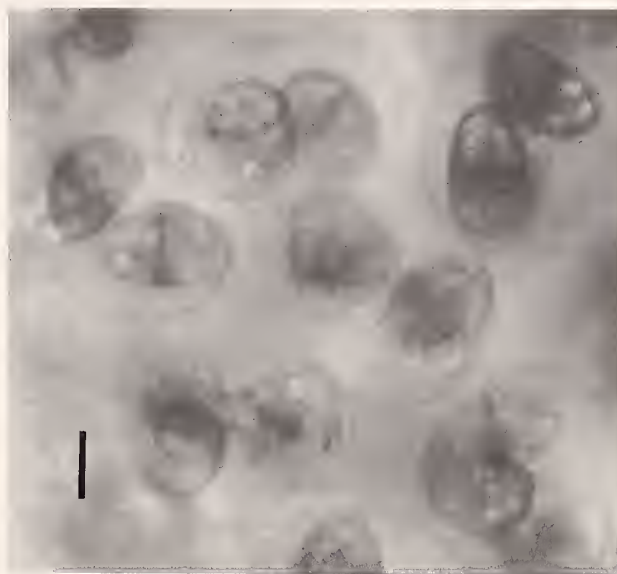


Figure 8

Twin embryos from the egg mass of *Elysia patagonica* Muniain & Ortea, sp. nov. Scale bar: 100  $\mu$ m.

from *E. patagonica*. Other important distinctive features present in *E. ornata* are the male and female separate follicles, a large, muscular penis, and the anterior follicles functioning as ampulla. Literature describing the egg mass in *Elysia* species is very scarce. Jensen (1992) mentioned the common occurrence of twin embryos egg masses from Atlantic specimens (Canary Islands) of *E. ornata*, in agreement with our observations in *E. patagonica*.

Another large tropical Atlantic species (maximum 40 mm) is *Elysia subornata* Verril, 1901. It can be distinguished by its general green coloration, with fine grayish white mottling, minutely papillose parapodia, and a renopericardial prominence which forms a long ridge along the body length. Another distinctive characteristic is the morphology of the radular teeth, which is very different from that of *E. patagonica*, since *E. subornata* is a caulerpivorous species (Marcus & Marcus, 1957; Clark & De Frees, 1987), showing teeth with broad tips.

The white patch on the head is present in all of our specimens, and we consider it a distinctive systematic feature for the species. Verril, 1900 indicated in *Elysia crispa* (Mörch, 1863) (misspelling name) from Bermuda, a squarish white spot on the back of the head and neck, with

Figure 6 (A–F)

Scanning electron micrograph of some elements of the radula of *Elysia patagonica* Muniain & Ortea, sp. nov. A. Entire radula, scale bar: 100  $\mu$ m. B. Teeth of ascending limb, scale bar: 10  $\mu$ m. C. Tooth: blade-shaped, blunt tip, and hooked base, scale bar: 10  $\mu$ m. D. Longest tooth: the first in the descending limb, scale bar: 10  $\mu$ m. E. Tip of tooth showing, finely denticulate, cutting edge, scale bar: 10  $\mu$ m. F. Details of discarded teeth in the ascus, scale bar: 10  $\mu$ m.



prolongations into the rhinophores. Marcus (1980) and Marcus & Marcus (1967) indicated that *E. tuca*, from Curaçao, has a white crosslike figure on the back of the head and a white triangle on the neck. Clark, 1984 commented on Verrill's mistake in identifying the species *Elysia tuca* Marcus, 1967. However, in *E. patagonica*, the white patch is only situated on the medial dorsal region of the head. Other distinctive features present in *E. tuca* are an armed penis, an elongate renopericardial prominence, and the distribution of anterior and posterior dorsal vessels (Marcus, 1980).

*Elysia viridis* (Montagu, 1804) is a species from the east Atlantic and Mediterranean coasts. This species is widely distributed from north of Europe to the South African coast (Eland's Bay, west Atlantic coast) (Gosliner, 1987a). The external appearances of *E. viridis* and *E. patagonica* are easily distinguished; *E. viridis* presents triangular parapodia, showing a long neck and short rhinophores with a violet edge. Other species of the genus *Elysia* cited from the South African coast (Macnae, 1954; Marcus & Marcus, 1966; Barnard, 1974; Gosliner, 1987a, b) have Indo-Pacific distribution and vivid bright colors. Another African green species, except *E. viridis*, is *Elysia halimeda* Macnae, 1954, and it is characterized by a stout body and subrectangular and short parapodia, distinguishable from *E. patagonica*.

Jensen (1980, 1983, 1993b) correlated morphological adaptations of sacoglossan radular teeth to the characteristics of the algae upon which they feed. According to Jensen, the dental morphology of *E. patagonica* shows the "blade-shaped cusp" type, with denticles along the cutting edges. This morphology is present in species which feed upon *Bryopsis* and *Chaetomorpha*. Atlantic species that feed on *Bryopsis* sp. are *E. ornata* and *E. viridis*. *Elysia viridis* is one of the few species which has a wide diet including filamentous algae (*Bryopsis*, *Chaetomorpha*) and pseudoparenchymatous (*Codium*) (Jensen, 1994). However, we have found all our specimens on *Bryopsis plumosa*, except one animal on *Codium*.

Gosliner (personal communication) suggests a similarity of *E. patagonica* to the Pacific species *E. hedgpethi* Marcus, 1961 (= *E. bedeckta* MacFarland, 1966), in general morphology, coloration, and use of the same algae (*Bryopsis*). However, MacFarland (1966) mentioned bright spots of different colors—blue, emerald green, bright red, and orange-yellow—which are absent in our specimens. Also, the long, narrow body with triangular parapodia ending in a point described for *E. hedgpethi* does not occur even in juvenile Patagonian specimens. In addition, the white patch on the head of our specimens is absent in Marcus & Marcus' (1961) and MacFarland's (1966) descriptions of *E. hedgpethi*. Both papers lack illustrations of the reproductive system, and only Marcus & Marcus partially analyzed it. A large hermaphrodite ampulla and receptacle genital observed in *E. patagonica* were not indicated in Marcus & Marcus' description.

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